The natural history of coal

There is perhaps no substance of vegetable origin of greater importance and intellectual interest than coal. Nevertheless, we are largely ignorant of its composition and mode of formation. What knowledge we possess is almost exclusively based on inferences drawn from the organization of the rocks lying above and below the actual coal beds. Obviously inferences derived from such data are as open to error as the judging of the character of a book from the nature of its bindings. The geologists have notably failed to give us any adequate description or explanation of this greatest of mineral products, and it is now obvious that we must look to the anatomist and the paleobotanist, in collaboration with the chemist and physicist, to clear up this literally as well as figuratively dark subject.

ARBER[3] has stated the problem in an admirably clear and succint way, and has interestingly summed up the history of our knowledge of coal to the present time, with indications of the probable lines of successful attack in the future. It is noteworthy that the greatest recent modifications of our views in regard to coal have come about from the successful preparation of microscopic sections of certain types by the French investigators BERTRAND and RENAULT. It is now realized that a considerable number of combustible minerals have been formed in open water, and are to a large degree composed of the remains of phytoplankton (autocthonous and allocthonous). This is notably the case with coals rich in gases and hydrocarbons, such as cannels, bogheads, oil shales, bituminous shales, etc. Our information in regard to the coals which are not bituminous, or at least not markedly so, is in a less advanced state on account of the impossibility until quite recently of securing sections of the coal substance sufficiently thin and decolored to show their organization. On this subject ARBER writes as follows: "If we prepare thin slices of coal, ... and examine them under the microscope, we shall find as a rule that they are very disappointing as regards the amount of information we can obtain from them. Such sections are usually opaque, even when quite thin, and the substance is obviously very homogeneous." Fortunately the difficulties here described have quite recently been almost entirely obviated, for it has been found possible to prepare fairly thin and translucent sections even by the grinding method used by the petrographer, and by a modified biological technique it becomes feasible to prepare transparent slices of practically all categories of coals.

The writer shows that the old chemico-physical hypothesis of the origin of the various categories of coal, the peat-to-anthracite theory, is no longer tenable, but must be replaced as our knowledge permits by biological and biochemical hypotheses. The nature of a coal, where we are at present acquainted with its real composition, depends as much as anything on the

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[3] ARBER, E. A. NEWELL, The natural history of coal. Cambridge Manuals of Science and Literature. pp. 163. *figs. 21.* Cambridge University Press. 1911. *1s.*

character of the plant remains which compose it, and to a much less degree on the chemical and physical conditions to which it has subsequently been exposed. It is accordingly clear that the study of coal is to a very large extent within the domain of the biologist, for certainly no adequate conception of the problem can be reached without his cooperation.

There are a few slips on the part of the author; for example he states that anthracite and cannel differ from ordinary so-called bituminous coal and oil shale or boghead respectively, by the fact that they contain little or no ash. Obviously this statement does not generally hold of these types of coal as mined in North America. ARBER has confined his observations in this respect to European coals. His book is nevertheless planned on the broadest lines, and is commended to all who wish to obtain a clear conception of our present knowledge of coal.—E. C. JEFFREY.

NOTES FOR STUDENTS

Recent work in gymnosperms.—In 1910 SCOTT and MASLEN established the genus *Mesoxylon* to include certain paleozoic stems intermediate in structure between *Poroxylon* and *Cordaites*, giving diagnoses of five species. One of these (*M. Sutcliffii*) has been described in detail by MASLEN,[4] and now two more species are described by SCOTT.[5] The conclusion is reached that *Mesoxylon* is "the last link in the chain of fossil types connecting the Pteridosperms with the typical *Cordaites* of the Upper Paleozoic," being definitely distinguished from it only by the presence of centripetal xylem in the stem. A critical discussion of the relationships of the new genera recently established by ZALESSKY is also given.

Mrs. THODAY and Miss BERRIDGE[6] have made an anatomical investigation of the strobili of four species of *Ephedra* (*E. altissima*, *E. distachya*, *E. fragilis*, *E. nebrodensis*). The "clearly bifid" stamen of the three last named species, each half bearing four bilocular synangia, is traced into other species in which the bifid character is not evident, but in which there are fusions of synangia into trilocular or even quadrilocular synangia, until *E. altissima* is reached with only two bilocular synangia. A reduction series is also traced from the staminate disk of *Cycadeoidea*, through other disks of Bennettitales, to *Ephedra*, where the disk is reduced to two segments, each bearing two pairs of bilocular synangia, and to *Welwitschia*, with its disk of six segments bearing trilocular synangia. It is also discovered that the solitary ovule of the species investigated is the product of a fusion of the two ovules of the biovulate species, since

[4] Rev. in BOT. GAZ. **52**:326. 1911.

[5] SCOTT, D. H., The structure of *Mesoxylon Lomaxii* and *M. poroxyloides*. Ann. Botany **26**:1011–1030. *pls. 87–90*. 1912.

[6] THODAY (SYKES), MARY G., and BERRIDGE, EMILY M., The anatomy and morphology of the inflorescences and flowers of *Ephedra*. Ann. Botany **26**:953–985. *figs. 21. pl. 85*. 1912.